UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2005/2006

April/May 2006

EEE 530 – COMMUNICATION CIRCUITS AND SYSTEMS

Time: 3 Hours

INSTRUCTION TO CANDIDATE:

Please check that this examination paper contains **SEVEN** pages of printed material before you begin the examination.

Answer **FIVE** questions.

All questions must be answered in English.

...2/-

1. (a) Describe 3 common receiver structures. Use block diagrams to describe them.

(20%)

(b) A receiver is to be designed to cover the frequencies of 30 to 50 MHz using an IF filter centered at 10 MHz. Specify two different local oscillator frequencies for each input frequency and determine the corresponding image frequency for each input frequency.

(40%)

(c) Figure 1 illustrates a direct conversion receiver in which the input signal is converted directly to an audio signal. Specify the local oscillator frequencies and the corresponding image frequencies for a direct conversion receiver covering 3-30 MHz range.

(40%)

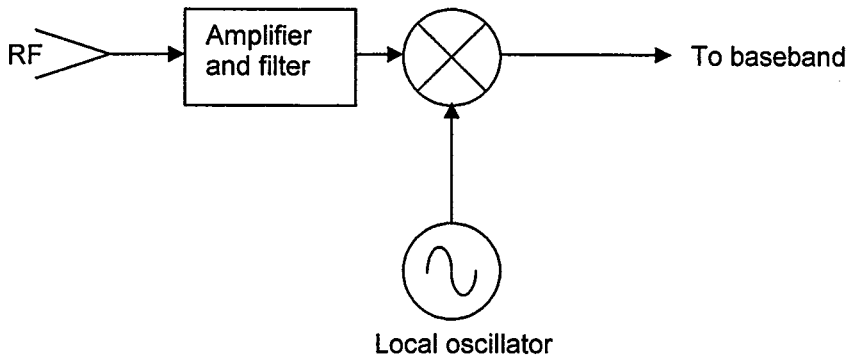

Figure 1

...3/-

2. (a) State what is the Nyquist Stability Criteria / Condition used in designing an oscillator.

(20%)

(b) Describe 3 types of oscillator using block diagrams to illustrate them

(20%)

(c) Draw the block diagram of the phase lock loop and explain the operation of the phase lock loop.

(20%)

(d) The prescaling frequency synthesizer of Figure 2 produces 20 output frequencies in the frequency range extending from 146.4 MHz to 148.0 MHz. The frequencies are equally spaced by 100 kHz. Determine

(i) The required divide-by-K factor

(ii) N_{min} and N_{max}

(40%)

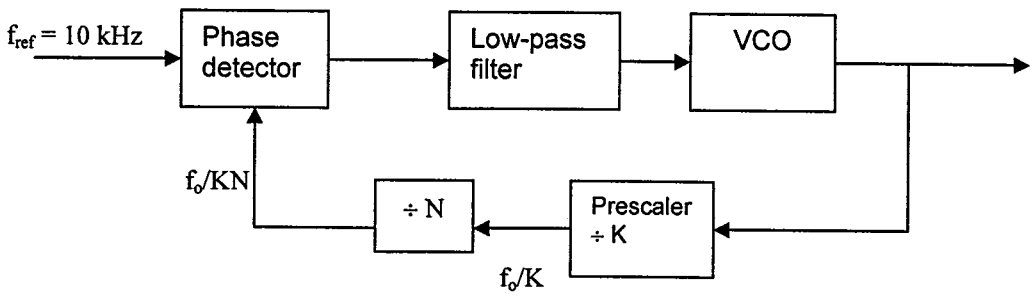

Figure 2

...4/-

3. (a) A 1800-Hz signal which has an amplitude of 30V amplitude modulates a 50-MHz carrier which when unmodulated has an amplitude of 65 V.

(i) Sketch the modulating signal
(ii) Sketch the carrier
(iii) Construct the modulated wave
(iv) Calculate the modulation factor and percent modulation of the modulated wave
(v) What frequencies would show up in a spectrum analysis of the AM wave

(50%)

(b) Discuss the comparison between, amplitude, angle and phase modulation using block diagrams.

(15%)

(c) A 50.004 MHz carrier is to be modulated by a 3-kHz audio tone resulting in a narrow band FM signal. Determine the bandwidth of the FM signal.

(15%)

(d) If an 18-MHz carrier is to be considered for use with the same standards that apply to the 88-108 MHz FM broadcast band, how many FM stations could be accommodated?

(20%)

4. (a) A discrete memory-less source has an alphabet of five equally likely symbols. Construct a Huffman code for the source and calculate its efficiency.

(50%)

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(b) A voice transmission system occupies a channel 30 kHz wide. Suppose a spread spectrum system is used to increase its bandwidth to 10 MHz. If the signal has a total signal power of -110 dBm at the receiver input and the system noise temperature referred to the same point is 300° Kelvin, calculate the signal to noise ratio for the two systems.

(30%)

Note: The thermal noise power is given by PN = kTB
PN = Noise power in watts.
K = Boltzman's constant = 1.38×10^{-23} Jouls/Kelvin
T = Absolute temperature in degrees Kelvin
B = Noise power bandwidth in Hz.
Power in dBm = 10 $\log_{10}$ [power in watts / 0.001]

(c) Explain what you understand by "Frequency reuse" in a cellular mobile system. With the help of proper diagrams explain the principle of the N=7 frequency plan for frequency reuse.

(20%)

5. (a) The three parity/check bits c_4, c_5, and c_6 of a (6, 3) linear block code is found from the following equations

$$c_4 = m_1 \oplus m_3$$
$$c_5 = m_1 \oplus m_2 \oplus m_3$$
$$c_6 = m_1 \oplus m_2$$

m_1, m_2, and m_3 are the message bits.

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(i) Write the generator matrix G for the code.

(ii) Determine all possible code words.

(iii) Determine the minimum distance for the code and hence state the error detection and correction capabilities of the code.

(iv) Suppose the received word is r = [010111]. Correctly decode the received word and determine the three message bits using the parity check matrix and the syndrome.

(50%)

(b) The T1 carrier system used in digital telephony multiplexes using TDM, 24 voice channels (signals) each band limited to 3.4 kHz. Each channel (signal) is sampled at a sampling frequency of 8 kHz and each sample value is coded into 8 bits. Calculate

(i) The resultant transmission rate of the multiplexed signal

(ii) The minimum required transmission bandwidth.

(30%)

(c) Explain the term "Hand-off" as applied to cellular mobile communication systems. With the help of appropriate diagrams explain how it is achieved.

(20%)

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6. (a) In a CDMA system using DSS the base-band (Narrow band) signal A is spread using the PN code B to give the composite wideband signal C. Show that the base-band signal A can be correctly recovered by de-spreading C with the same PN code B.

(40%)

(b) Briefly describe what is Bluetooth and how does it work. Also discuss some of the major applications of this technology.

(40%)

(c) A discrete memory-less source has four symbols x_1, x_2, x_3, and x_4 with probabilities $p(x_1)=0.4$, $p(x_2)=0.3$, $p(x_3)=0.2$ and $p(x_4)=0.1$. Calculate the entropy of the source.

(20%)

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